

## SEQUENCE LISTING

<110> Frohberg, Claus  
Koetting, Oliver

Ritte, Gerhard  
Steup, Martin

<120> Plants with increased activity of multiple starch phosphorylating enzymes

<130> 65084.000022

<140> Unassigned  
<141> 2006-09-01

<150> EP 04090089.6

<151> 2004-03-05

<150> US 60/550,021

<151> 2004-03-05

<150> EP 04090284.3

<151> 2004-07-21

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<151> 2004-03-29

<160> 39

<170> PatentIn version 3.1

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Gly Gly Arg Pro Arg Arg Gly Leu Val Leu Pro Pro Gly Val Gly  
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Ala Gly Val Leu Leu Arg Arg Gly Ala Met Ala Leu Pro Gly Arg Arg  
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Gly Phe Ala Cys Arg Gly Arg Ser Ala Ala Ser Ala Ala Glu Arg Thr  
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Lys Glu Lys Lys Arg Arg Asp Ser Ser Lys Gln Pro Leu Val His Leu  
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175 180 185

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190 195

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tcc Ser	ttt Phe	aca Thr	agc Ser 945	ctt Leu	cta Leu	gaa Glu	aag Lys	att Ile 950	gaa Glu	aca Thr	gcc Ala	aaa Lys	gtc Val 955	gaa Glu	aat Asn	2883	
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1205

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Cys Arg Gly Arg Ser Ala Ala Ser Ala Ala Glu Arg Thr Lys Glu Lys  
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Lys Arg Arg Asp Ser Ser Lys Gln Pro Leu Val His Leu Gln Val Cys  
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Glu Phe Lys Phe Val Ile Phe Leu Val Gly Gly Lys Asp Lys Ile Trp  
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Asp Ile Val Cys His Trp Asn Arg Thr Glu Glu Pro Leu Glu Leu Leu  
165 170 175

Gly Thr Pro Lys Phe Glu Leu Val Gly Glu Ala Glu Lys Asn Thr Gly  
180 185 190

Glu Asp Ala Ser Ala Ser Val Thr Phe Ala Pro Glu Lys Val Gln Asp  
Page 17

195

200

205

Ile Ser Val Val Glu Asn Gly Asp Pro Ala Pro Glu Ala Glu Ser Ser  
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Asn Trp Trp Arg Lys Leu Glu Val Val Arg Gly Ile Leu Ser Glu Ser  
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Phe Asp Asp Gln Ser Arg Leu Gly Ala Leu Val Tyr Ser Ala Ile Tyr  
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His His Arg Pro Asn Lys His Ala Glu Ile Ser Arg Gln Ile Phe Arg  
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Leu Val Ile Arg Lys Ile His Pro Phe Leu Pro Ser Phe Lys Ser Glu  
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Phe Thr Ala Ser Val Pro Leu Thr Arg Ile Arg Asp Ile Ala His Arg  
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Asn Asp Ile Pro His Asp Leu Lys Gln Glu Ile Lys His Thr Ile Gln  
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Val Met Leu Ala Arg Ile Thr Lys Thr Pro Gly Glu Tyr Ser Glu Thr  
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Phe Val Glu Gln Phe Thr Ile Phe Tyr Ser Glu Leu Lys Asp Phe Phe  
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Asn Ala Gly Ser Leu Phe Glu Gln Leu Glu Ser Ile Lys Glu Ser Leu

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455

460

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Ala Leu Gly Gly Ser Ala Ser Leu Ala Lys Asp Val Ala Arg Asn Thr  
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 580 585 590

Val Ser Phe Ser Gly Trp Lys Thr Asp Glu Cys Ile Ala Ile Gly Asn  
 595 600 605

Glu Ile Leu Ser Trp Lys Gln Lys Gly Leu Ser Glu Ser Glu Gly Cys  
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Glu Asp Gly Lys Tyr Ile Trp Ser Leu Arg Leu Lys Ala Thr Leu Asp  
 625 630 635 640

Arg Ala Arg Arg Leu Thr Glu Glu Tyr Ser Glu Ala Leu Leu Ser Ile  
 645 650 655

Phe Pro Glu Lys Val Met Val Ile Gly Lys Ala Leu Gly Ile Pro Asp  
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Asn Ser Val Arg Thr Tyr Thr Glu Ala Glu Ile Arg Ala Gly Ile Val  
 675 680 685

Phe Gln Val Ser Lys Leu Cys Thr Val Leu Gln Lys Ala Ile Arg Glu  
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Val Leu Gly Ser Thr Gly Trp Asp Val Leu Val Pro Gly Val Ala His  
 Page 19

705		710		715		720
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Asp Ser Leu Ala Leu Glu Leu Gln Ala Ile Ile Ser His Leu Ser Pro						

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975

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Glu Ala Ala Arg Thr Glu Leu Leu Glu Glu Ile Val Arg Gly Thr Ser  
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Val Glu Asp Leu Arg Ala Lys Leu Thr Asn Lys Asn Asp Arg Gln Glu  
 275 280 285

Ile Lys Glu Ser Ser Ser His Gly Thr Lys Asn Ala Ile Pro Asp Asp  
 290 295 300

Leu Val Gln Ile Gln Ser Tyr Ile Arg Trp Glu Arg Ala Gly Lys Pro  
 305 310 315 320

Asn Tyr Ser Ala Asp Gln Gln Leu Arg Glu Phe Glu Glu Ala Arg Lys  
 325 330 335

Glu Leu Gln Ser Glu Leu Glu Lys Gly Ile Ser Leu Asp Glu Ile Trp  
 340 345 350

Lys Lys Ile Thr Lys Gly Glu Ile Gln Thr Lys Val Ser Asp Gln Leu  
 355 360 365

Lys Thr Lys Lys Tyr Phe Arg Thr Glu Arg Ile Gln Arg Lys Gln Arg  
 370 375 380

Asp Phe Met Gln Ile Leu Asn Lys His Val Ala Glu Pro Thr Glu Lys  
 385 390 395 400

Lys Asn Ile Ser Val Glu Pro Lys Ala Leu Thr Pro Val Glu Leu Phe  
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Val Gly Ala Thr Glu Glu Gln Glu Gly Asp Ser Ile Leu Asn Lys Lys  
 420 425 430

Ile Tyr Lys Leu Ala Gly Lys Glu Leu Leu Val Leu Val His Lys Pro  
 435 440 445

Gly Gly Lys Thr Lys Ile His Leu Ala Thr Asp Gly Lys Glu Pro Leu  
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450

455

460

Ile Leu His Trp Ala Leu Ser Lys Lys Ala Gly Glu Trp Leu Ala Pro  
 465 470 475 480

Pro Pro Ser Val Leu Pro Ala Gly Ser Val Leu Leu Ser Gly Ser Val  
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Glu Thr Thr Phe Thr Thr Ser Ser Leu Ala Asp Leu Pro Tyr Gln Val  
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Gln Ser Ile Glu Ile Glu Ile Glu Glu Glu Gly Tyr Val Gly Met Pro  
 515 520 525

Ser Val Leu Gln Ser Gly Gly Asn Trp Ile Lys Asn Lys Gly Ser Asp  
 530 535 540

Phe Tyr Val Asp Phe Ser Tyr Glu Ser Lys Gln Val Gln Gln Asp Phe  
 545 550 555 560

Gly Asp Gly Lys Gly Thr Ala Lys Ala Leu Leu Glu Lys Ile Ala Gly  
 565 570 575

Leu Glu Ile Glu Ala Gln Lys Ser Phe Met His Arg Phe Asn Ile Ala  
 580 585 590

Ala Asp Leu Ile Gln Glu Ala Lys Glu Ala Gly Glu Leu Gly Phe Ala  
 595 600 605

Gly Ile Leu Val Trp Met Arg Phe Met Ala Thr Arg Gln Leu Ile Trp  
 610 615 620

Asn Lys Asn Tyr Asn Val Lys Pro Arg Glu Ile Ser Lys Ala Gln Asp  
 625 630 635 640

Arg Leu Thr Asp Leu Leu Gln Asn Val Tyr Ile Ser Asn Pro Glu Tyr  
 645 650 655

Arg Glu Ile Val Arg Met Ile Leu Ser Thr Val Gly Arg Gly Gly Glu  
 660 665 670

Gly Asp Val Gly Gln Arg Ile Arg Asp Glu Ile Leu Val Ile Gln Arg  
 675 680 685

Asn Asn Asn Cys Lys Gly Gly Met Met Glu Glu Trp His Gln Lys Leu  
 690 695 700

His Asn Asn Thr Ser Pro Asp Asp Val Ile Ile Cys Gln Ala Leu Ile

705		710		715		720
Asp Tyr Ile Lys	Ser 725	Asp Phe Asp Ile	Ser 730	Ala Tyr Trp Lys	Thr 735	Leu
Asn Asp Asn Gly	Ile 740	Thr Lys Glu	Arg 745	Leu Leu Ser Tyr	Asp 750	Arg Ala
Ile His Ser	Glu 755	Pro Asn Phe	Arg 760	Asp Gln Lys	Asp 765	Gly Leu Leu
Arg Asp	Leu 770	Gly Asn Tyr	Met 775	Arg Thr Leu Lys	Ala 780	Val His Ser Gly
Ala Asp	Leu 785	Glu Ser	Ala 790	Ile Thr Asn Cys	Leu 795	Gly Tyr Arg Ser Glu 800
Gly Gln Gly Phe	Met 805	Val Gly Val Gln	Ile 810	Asn Pro Ile Pro	Asn 815	Leu
Pro Ser Gly	Phe 820	Pro Glu Leu Leu	Gln 825	Phe Val Ser Glu	His 830	Val Glu
Asp Arg	Asn 835	Val Glu Ala Leu	Leu 840	Glu Gly Leu Leu	Glu 845	Ala Arg Gln
Glu Ile	Arg 850	Pro Leu Leu	Cys 855	Lys His Asn Asp	Arg 860	Leu Lys Asp Leu
Leu Phe	Leu 865	Asp Ile	Ala 870	Leu Glu Ser Ser	Val 875	Arg Thr Ala Ile Glu 880
Lys Gly Tyr	Glu 885	Glu Leu Asn Glu	Ala 890	Gly Pro Glu Lys	Ile 895	Met Tyr
Phe Val	Ser 900	Leu Ile Leu Glu	Asn 905	Leu Ala Leu Ser	Leu 910	Asp Asp Asn
Glu Asp	Leu 915	Ile Tyr Cys Leu	Lys 920	Gly Trp Ser Asn	Ala 925	Leu Ser Met
Ser Lys	Ser 930	Lys Ser Asp	Asn 935	Trp Ala Leu Phe	Ala 940	Lys Ser Val Leu
Asp Arg	Thr 945	Arg Leu	Ala 950	Leu Ala Gly Lys	Ala 955	Asp Trp Tyr Gln Lys 960
Val Leu Gln Pro	Ser 965	Ala Glu Tyr Leu	Gly Thr Leu Leu	Ser Val Asp		



975

Leu Ser Asp Asp Ile Asn Gln Ala Val Ala Glu Lys Leu Gln Ile  
Page 33

1205	1210	1215
Leu Lys Gln Lys Leu Gly Glu 1220	Glu Asp His Ser Ala 1225	Leu Arg Glu 1230
Ile Arg Glu Thr Val Leu 1235	Gln Met Lys Ala Pro Asn 1240	Gln Leu Val 1245
Gln Glu Leu Lys Thr Glu 1250	Met Lys Ser Ser Gly Met 1255	Pro Trp Pro 1260
Gly Asp Glu Gly Glu Gln 1265	Arg Trp Glu Gln Ala Trp 1270	Met Ala Ile 1275
Lys Lys Val Trp Ala Ser 1280	Lys Trp Asn Glu Arg Ala 1285	Phe Phe Ser 1290
Thr Arg Arg Val Lys Leu 1295	Asp His Glu Tyr Leu Cys 1300	Met Ala Val 1305
Leu Val Gln Glu Ile Ile 1310	Asn Ala Asp Tyr Ala Phe 1315	Val Ile His 1320
Thr Thr Asn Pro Ser Ser 1325	Gly Asp Ser Ser Glu Ile 1330	Tyr Ala Glu 1335
Val Val Lys Gly Leu Gly 1340	Glu Thr Leu Val Gly Ala 1345	Tyr Pro Gly 1350
Arg Ala Leu Ser Phe Val 1355	Cys Lys Lys Asn Asp Leu 1360	Lys Ser Pro 1365
Arg Val Leu Gly Tyr Pro 1370	Ser Lys Pro Ile Gly Leu 1375	Phe Ile Arg 1380
Arg Ser Ile Ile Phe Arg 1385	Ser Asp Ser Asn Gly Glu 1390	Asp Leu Glu 1395
Gly Tyr Ala Gly Ala Gly 1400	Leu Tyr Asp Ser Val Pro 1405	Met Asp Glu 1410
Ala Glu Lys Val Val Leu 1415	Asp Tyr Ser Ser Asp His 1420	Leu Ile Thr 1425
Asp Gly His Phe Gln Gln 1430	Ser Ile Leu Ser Ser Ile 1435	Ala Arg Ala 1440
Gly Cys Glu Ile Glu Glu Leu	Phe Gly Ser Ala Gln	Asp Ile Glu

1445

1450

1455

Gly Val Val Arg Asp Gly Lys Ile Tyr Val Val Gln Thr Arg Pro  
 1460 1465 1470

Gln Met  
 1475

&lt;210&gt; 8

&lt;211&gt; 4200

&lt;212&gt; DNA

&lt;213&gt; Arabidopsis thaliana

&lt;220&gt;

&lt;221&gt; CDS

&lt;222&gt; (1)..(4200)

&lt;223&gt;

&lt;300&gt;

&lt;308&gt; EMBL / AF312027

&lt;309&gt; 2001-01-08

&lt;400&gt; 8

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Met	Ser	Asn	Ser	Val	Val	His	Asn	Leu	Leu	Asn	Arg	Gly	Leu	Ile	Arg	
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cct	ctt	aac	ttt	gaa	cat	caa	aac	aag	ctc	aac	tcc	tct	gtg	tac	caa	96
Pro	Leu	Asn	Phe	Glu	His	Gln	Asn	Lys	Leu	Asn	Ser	Ser	Val	Tyr	Gln	
			20					25					30			

act	tca	aca	gca	aat	ccg	gct	ctt	ggc	aag	att	ggc	aga	tca	aaa	ctt	144
Thr	Ser	Thr	Ala	Asn	Pro	Ala	Leu	Gly	Lys	Ile	Gly	Arg	Ser	Lys	Leu	
		35					40					45				

tac	ggg	aaa	ggt	ctt	aag	cag	gca	gga	cgc	agt	ctg	gtc	act	gaa	aca	192
Tyr	Gly	Lys	Gly	Leu	Lys	Gln	Ala	Gly	Arg	Ser	Leu	Val	Thr	Glu	Thr	
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gga	gga	aga	cct	ctc	tca	ttt	gtt	cca	cga	gct	gtc	ctt	gcc	atg	gat	240
Gly	Gly	Arg	Pro	Leu	Ser	Phe	Val	Pro	Arg	Ala	Val	Leu	Ala	Met	Asp	
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cct	cag	gca	gcc	gag	aaa	ttt	agt	ctt	gac	gga	aat	atc	gat	tta	ctg	288
Pro	Gln	Ala	Ala	Glu	Lys	Phe	Ser	Leu	Asp	Gly	Asn	Ile	Asp	Leu	Leu	
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tat Tyr	aca Thr	agt Ser 115	gac Asp	aca Thr	ttg Leu	ttc Phe	cta Leu 120	cac His	tgg Trp	ggt Gly	gca Ala	att Ile 125	ctt Leu	gac Asp	aac Asn	384
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ttc Phe 145	aag Lys	aac Asn	agt Ser	gcg Ala	ctt Leu 150	aga Arg	act Thr	cca Pro	ttt Phe	gtg Val 155	aaa Lys	tcc Ser	ggt Gly	ggc Gly	aat Asn 160	480
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gtt Val	tct Ser 210	gtt Val	cct Pro	gaa Glu	gat Asp	ctt Leu 215	gta Val	cag Gln	atc Ile	caa Gln	gca Ala 220	tat Tyr	ctt Leu	aga Arg	tgg Trp	672
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tcc Ser	tta Leu	aca Thr	act Thr 340	ctg Leu	gag Glu	ata Ile	tac Tyr	gcc Ala 345	aaa Lys	gca Ala	aag Lys	gag Glu	gaa Glu 350	caa Gln	gaa Glu	1056

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Ile Leu Met Lys 1210 Lys Leu Ser Glu Gly 1215 Asp Phe Ser Ala Leu 1220 Gly	
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Glu Ile Arg Thr 1225 Thr Val Leu Asp Leu 1230 Ser Ala Pro Ala Gln 1235 Leu	
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Val Lys Glu Leu 1240 Lys Glu Lys Met Gln 1245 Gly Ser Gly Met Pro 1250 Trp	
cct ggt gat gaa ggt cca aag cgg tgg gaa caa gca tgg atg gcc	3902
Pro Gly Asp Glu 1255 Gly Pro Lys Arg Trp 1260 Glu Gln Ala Trp Met 1265 Ala	
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Ile Lys Lys Val 1270 Trp Ala Ser Lys Trp 1275 Asn Glu Arg Ala Tyr 1280 Phe	
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Ser Thr Arg Lys 1285 Val Lys Leu Asp His 1290 Asp Tyr Leu Cys Met 1295 Ala	
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Val Leu Val Gln 1300 Glu Ile Ile Asn Ala 1305 Asp Tyr Ala Phe Val 1310 Ile	
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His Thr Thr Asn 1315 Pro Ser Ser Gly Asp 1320 Asp Ser Glu Ile Tyr 1325 Ala	
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Glu Val Val Arg 1330 Gly Leu Gly Glu Thr 1335 Leu Val Gly Ala Tyr 1340 Pro	
gga cgt gct ttg agt ttt atc tgc aag aaa aag gat ctc aac tct	4172
Gly Arg Ala Leu 1345 Ser Phe Ile Cys Lys 1350 Lys Lys Asp Leu Asn 1355 Ser	

cct caa gtg tta ggt tac cca agc aaa ccg atc ggc ctt ttc ata	4217
Pro Gln Val Leu Gly Tyr Pro Ser Lys Pro Ile Gly Leu Phe Ile	
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Lys Arg Ser Ile Ile Phe Arg Ser Asp Ser Asn Gly Glu Asp Leu	
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Glu Gly Tyr Ala Gly Ala Gly Leu Tyr Asp Ser Val Pro Met Asp	
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Glu Glu Glu Lys Val Val Ile Asp Tyr Ser Ser Asp Pro Leu Ile	
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Thr Asp Gly Asn Phe Arg Gln Thr Ile Leu Ser Asn Ile Ala Arg	
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Ala Gly His Ala Ile Glu Glu Leu Tyr Gly Ser Pro Gln Asp Ile	
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Thr Glu Phe Arg Gly Asn Arg Leu Lys Val Gln Lys Lys Lys Ile Pro  
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Met Glu Lys Lys Arg Ala Phe Ser Ser Ser Pro His Ala Val Leu Thr  
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Thr Asp Thr Ser Ser Glu Leu Ala Glu Lys Phe Ser Leu Gly Gly Asn  
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Ile Glu Leu Gln Val Asp Val Arg Pro Pro Thr Ser Gly Asp Val Ser  
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Phe Val Asp Phe Gln Val Thr Asn Gly Ser Asp Lys Leu Phe Leu His  
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Trp Gly Ala Val Lys Phe Gly Lys Glu Thr Trp Ser Leu Pro Asn Asp  
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Arg Pro Asp Gly Thr Lys Val Tyr Lys Asn Lys Ala Leu Arg Thr Pro  
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Phe Val Lys Ser Gly Ser Asn Ser Ile Leu Arg Leu Glu Ile Arg Asp  
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Thr Ala Ile Glu Ala Ile Glu Phe Leu Ile Tyr Asp Glu Ala His Asp  
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Lys Trp Ile Lys Asn Asn Gly Gly Asn Phe Arg Val Lys Leu Ser Arg  
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Lys Glu Ile Arg Gly Pro Asp Val Ser Val Pro Glu Glu Leu Val Gln  
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Ile Gln Ser Tyr Leu Arg Trp Glu Arg Lys Gly Lys Gln Asn Tyr Pro  
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Pro Glu Lys Glu Lys Glu Glu Tyr Glu Ala Ala Arg Thr Val Leu Gln  
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Glu Glu Ile Ala Arg Gly Ala Ser Ile Gln Asp Ile Arg Ala Arg Leu  
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Thr Lys Thr Asn Asp Lys Ser Gln Ser Lys Glu Glu Pro Leu His Val  
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Thr Lys Ser Asp Ile Pro Asp Asp Leu Ala Gln Ala Gln Ala Tyr Ile  
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 Lys Thr Lys Val Glu Lys His Leu Lys Arg Ser Ser Phe Ala Val Glu  
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 Asp Gly Asn Phe Val Gly Met Pro Phe Val Leu Leu Ser Gly Glu Lys  
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Phe Met His Arg Phe Asn Ile Ala Ala Asp Leu Ile Glu Asp Ala Thr  
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Ala Phe Thr Ser His Pro Gln Tyr Arg Glu Ile Leu Arg Met Ile Met  
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Met Gln Glu Trp His Gln Lys Leu His Asn Asn Thr Ser Pro Asp Asp  
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Val Val Ile Cys Gln Ala Leu Ile Asp Tyr Ile Lys Ser Asp Phe Asp  
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Arg Leu Leu Ser Tyr Asp Arg Ala Ile His Ser Glu Pro Asn Phe Arg  
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Gly Asp Gln Lys Gly Gly Leu Leu Arg Asp Leu Gly His Tyr Met Arg  
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Thr Leu Lys Ala Val His Ser Gly Ala Asp Leu Glu Ser Ala Ile Ala  
 770 775 780

Asn Cys Met Gly Tyr Lys Thr Glu Gly Glu Gly Phe Met Val Gly Val  
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 850 855 860  
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 Gly Trp Asn Gln Ala Leu Ser Met Ser Asn Gly Gly Asp Asn His Trp  
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Cys	Phe	Asp	Pro	Asn	Ile	Leu	Ala	Asp	Leu	Gln	Ala	Lys	Glu	Gly
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Lys Asn Arg Ala Leu Arg Thr Pro Phe Ile Lys Ser Gly Asp Asn Ser	
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Arg Pro Gln Met			
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Thr Leu Ala Val Ser Arg Arg Ser Leu Leu Ala Pro Arg Ala Ile Ala  
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Ala Ser Thr Gly Arg Ala Ser Pro Gly Leu Val Gly Arg Phe Thr Leu  
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Asp Ala Asn Ser Glu Leu Lys Val Thr Leu Asn Pro Ala Pro Gln Gly  
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Ser Val Val Glu Ile Asn Leu Glu Ala Thr Asn Thr Ser Gly Ser Leu  
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Pro Ser Arg Lys Pro Asp Gly Thr Thr Val Tyr Lys Asn Arg Ala Leu  
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Arg Thr Pro Phe Ile Lys Ser Gly Asp Asn Ser Thr Leu Lys Ile Glu  
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Ile Asp Asp Pro Ala Val Gln Ala Ile Glu Phe Leu Ile Phe Asp Glu  
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Ala Arg Asn Asn Trp Tyr Lys Asn Asn Gly Gln Asn Phe Gln Ile Gln  
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Leu Gln Ala Ser Gln Tyr Gln Gly Gln Gly Thr Ser Thr Ala Thr Ser  
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Ser Thr Val Val Pro Glu Asp Leu Val Gln Ile Gln Ser Tyr Leu Arg  
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Glu Tyr Glu Ala Ala Arg Thr Glu Leu Ile Glu Glu Leu Asn Lys Gly  
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Val Ser Leu Glu Lys Leu Arg Ala Lys Leu Thr Lys Thr Pro Glu Ala  
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Thr Asp Ser Asn Ala Pro Ala Ser Glu Ser Thr Val Thr Thr Lys Val  
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Pro Glu Glu Leu Val Gln Val Gln Ala Tyr Ile Arg Trp Glu Lys Ala  
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Gln Leu Arg Asn Lys Ile Leu Lys Gly Asn Ile Glu Thr Lys Val Ser  
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Lys Gln Leu Lys Asp Lys Lys Tyr Phe Ser Val Glu Arg Ile Gln Arg  
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Lys Lys Arg Asp Ile Val Gln Leu Leu Lys Lys His Lys Pro Thr Val  
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Phe Thr Lys Ser Leu Gln Glu Gln Asp Asn Cys Glu Val Leu Ser Arg  
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Lys Leu Phe Lys Phe Gly Asp Lys Glu Ile Leu Gly Ile Thr Thr Val  
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 Ala Leu Gly Lys Thr Lys Val His Leu Ala Thr Asn Tyr Met Glu Pro  
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 Tyr Leu Asp Phe Ser Thr Lys Val Ala Lys Asn Thr Lys Asp Thr Gly  
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 Arg Phe Thr Asp Asp Leu Glu Asn Met Tyr Arg Thr Tyr Pro Gln Tyr  
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 Gly Asp Val Gly Gln Arg Ile Arg Asp Glu Ile Leu Val Ile Gln Arg  
 660 665 670

Asn Asn Asp Cys Lys Gly Gly Met Met Glu Glu Trp His Gln Lys Leu  
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 His Asn Asn Thr Ser Pro Asp Asp Val Val Ile Cys Gln Ala Leu Leu  
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 Lys Lys Gly Gly Ile Thr Lys Glu Arg Leu Leu Ser Tyr Asp Arg Pro  
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 Ile His Ser Glu Pro Asn Phe Arg Ser Glu Gln Lys Asp Ser Leu Leu  
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 Ala Asp Leu Glu Ser Ala Ile Ala Thr Cys Met Gly Tyr Lys Ser Glu  
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 Gly Glu Gly Phe Met Val Gly Val Gln Ile Asn Pro Val Lys Gly Leu  
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 Phe Ile Ser Leu Val Leu Glu Asn Leu Ala Leu Ser Thr Asp Asp Asn  
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 Thr Val Leu Asn Leu Thr Ala Pro Thr Gln Leu Ile Lys Glu Leu  
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 Gly Asp Gln Arg Trp Glu Gln Ala Trp Met Ala Ile Lys Lys Val  
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 Val Lys Leu Asp His Asp Tyr Leu Ser Met Ala Val Leu Val Gln  
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 Asn Leu Phe Leu Ala Pro Thr Asn Phe Arg Gly Ser Arg Leu Cys Val  
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agg aaa cgc aaa tta acc atg gga agg cac cac cac cgc cac gtt gac 306  
 Arg Lys Arg Lys Leu Thr Met Gly Arg His His His Arg His Val Asp  
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25

30

Lys Gly Lys Lys Asn Leu Phe Leu Ala Pro Thr Asn Phe Arg Gly Ser  
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Arg Leu Cys Val Arg Lys Arg Lys Leu Thr Met Gly Arg His His His  
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Arg His Val Asp Ala Val Pro Arg Ala Val Leu Thr Thr Asn Leu Ala  
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Ser Glu Leu Ser Gly Lys Phe Asn Leu Asp Gly Asn Ile Glu Leu Gln  
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 Page 79

275

280

285

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Ile Pro Phe Val Ile Leu Ser Asp Gly Glu Trp Ile Lys Asn Asn Gly  
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Ser Asn Phe Tyr Ile Glu Phe Gly Gly Lys Lys Gln Lys Gln Lys Asp  
Page 80



530

535

540

Phe Gly Asn Gly Lys Gly Thr Ala Lys Phe Leu Leu Asn Lys Ile Ala  
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Glu Met Glu Ser Glu Ala Gln Lys Ser Phe Met His Arg Phe Asn Ile  
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Glu Gly Gln Gly Phe Met Val Gly Val Lys Ile Asn Pro Val Pro Gly  
Page 81

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Gln Glu	Leu 835	Gln Pro Ser Leu	Ser 840	Lys Ser Gln Ser	Arg 845	Leu Lys Asp
Leu Ile	Phe 850	Leu Asp Val	Ala 855	Leu Asp Ser Thr	Val 860	Arg Thr Ala Val
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Met Cys	Lys 915	Ile Lys Asp Thr	His 920	Trp Ala Leu Tyr	Ala 925	Lys Ser Val
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Asp Lys Trp Ala	Val 960	Glu Ile Phe Thr	Glu 965	Glu Ile Ile Arg	Ala 970	Gly
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cct gag tcg gat gaa agt aaa tct tct gca tct cga atg ccc atc ggt Pro Glu Ser Asp Glu Ser Lys Ser Ser Ala Ser Arg Met Pro Ile Gly 280 285 290	1039
aaa ctt cca gag gat ctt gta cag gtg cag gct tat ata agg tgg gag Lys Leu Pro Glu Asp Leu Val Gln Val Gln Ala Tyr Ile Arg Trp Glu 295 300 305 310	1087
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gtt tcc aag cag ctg aag aac aag aag tac ttc tct gta gaa agg att Val Ser Lys Gln Leu Lys Asn Lys Lys Tyr Phe Ser Val Glu Arg Ile 360 365 370	1279
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aca ctt gtg gaa gat aaa gta gag gtt gta cca aaa caa cca act gtt Thr Leu Val Glu Asp Lys Val Glu Val Val Pro Lys Gln Pro Thr Val 395 400 405	1375
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tgc cag gcc tta att gat tat atc aag agt gac ttt gat ata agc gtt Cys Gln Ala Leu Ile Asp Tyr Ile Lys Ser Asp Phe Asp Ile Ser Val 715 720 725	2335
tac tgg gac acc ttg aac aaa aat ggc ata acc aaa gag cgt ctc ttg Tyr Trp Asp Thr 730 Leu Asn Lys Asn Gly Ile Thr Lys Glu Arg Leu Leu 735 740	2383
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gct gtg cat tct ggt gct gat ctt gaa tct gct ata gca agt tgt atg Ala Val His Ser Gly Ala Asp Leu Glu Ser Ala Ile Ala Ser Cys Met 775 780 785 790	2527
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gcc Ala	tat Tyr 1345	cct Pro	ggt Gly	cgt Arg	gct Ala	atg Met 1350	agc Ser	ttt Phe	ggt Val	tgc Cys	aaa Lys 1355	aaa Lys	gat Asp	gac Asp	4231
ctt Leu	gac Asp 1360	tct Ser	ccc Pro	aag Lys	tta Leu	ctt Leu 1365	ggt Gly	tac Tyr	cca Pro	agc Ser	aag Lys 1370	cca Pro	att Ile	ggt Gly	4276
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ccg Pro	atg Met 1405	gat Asp	gag Glu	gag Glu	gat Asp	gag Glu 1410	gtt Val	gta Val	ctt Leu	gat Asp	tat Tyr 1415	aca Thr	act Thr	gac Asp	4411

cct ctt ata gta gac cgt gga ttc cga agc tca atc ctc tca agc	4456
Pro Leu Ile Val Asp Arg Gly Phe Arg Ser Ser Ile Leu Ser Ser	
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Ile Ala Arg Ala Gly His Ala Ile Glu Glu Leu Tyr Gly Ser Pro	
1435 1440 1445	

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Gln Asp Val Glu Gly Val Val Lys Asp Gly Lys Ile Tyr Val Val	
1450 1455 1460	

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Gln Thr Arg Pro Gln Met	
1465	

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Gln Gln Gln Pro Gln Pro Ala Ser Leu Arg Arg Ser Gly Gly Gln Arg
35 40 45

Arg Pro Thr Thr Leu Ser Ala Ser Ser Arg Gly Pro Val Val Pro Arg
50 55 60

Ala Val Ala Thr Ser Ala Asp Arg Ala Ser Pro Asp Leu Ile Gly Lys
65 70 75 80

Phe Thr Leu Asp Ser Asn Ser Glu Leu Gln Val Ala Val Asn Pro Ala
85 90 95

Pro Gln Gly Leu Val Ser Glu Ile Ser Leu Glu Val Thr Asn Thr Ser
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100	105	110
Gly Ser Leu Ile Leu His Trp	Gly Ala Leu Arg Pro Asp Lys Arg Asp	
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Trp Ile Leu Pro Ser Arg Lys	Pro Asp Gly Thr Thr Val Tyr Lys Asn	
130	135	140
Arg Ala Leu Arg Thr Pro Phe Val Lys Ser Gly Asp Asn Ser Thr Leu		
145	150	155
Arg Ile Glu Ile Asp Asp Pro Gly Val His Ala Ile Glu Phe Leu Ile		
165	170	175
Phe Asp Glu Thr Gln Asn Lys Trp Phe Lys Asn Asn Gly Gln Asn Phe		
180	185	190
Gln Val Gln Phe Gln Ser Ser Arg His Gln Gly Thr Gly Ala Ser Gly		
195	200	205
Ala Ser Ser Ser Ala Thr Ser Thr Leu Val Pro Glu Asp Leu Val Gln		
210	215	220
Ile Gln Ala Tyr Leu Arg Trp Glu Arg Arg Gly Lys Gln Ser Tyr Thr		
225	230	235
Pro Glu Gln Glu Lys Glu Glu Tyr Glu Ala Ala Arg Ala Glu Leu Ile		
245	250	255
Glu Glu Val Asn Arg Gly Val Ser Leu Glu Lys Leu Arg Ala Lys Leu		
260	265	270
Thr Lys Ala Pro Glu Ala Pro Glu Ser Asp Glu Ser Lys Ser Ser Ala		
275	280	285
Ser Arg Met Pro Ile Gly Lys Leu Pro Glu Asp Leu Val Gln Val Gln		
290	295	300
Ala Tyr Ile Arg Trp Glu Gln Ala Gly Lys Pro Asn Tyr Pro Pro Glu		
305	310	315
Lys Gln Leu Val Glu Phe Glu Glu Ala Arg Lys Glu Leu Gln Ala Glu		
325	330	335
Val Asp Lys Gly Ile Ser Ile Asp Gln Leu Arg Gln Lys Ile Leu Lys		
340	345	350
Gly Asn Ile Glu Ser Lys Val Ser Lys Gln Leu Lys Asn Lys Lys Tyr		

355

360

365

Phe Ser Val Glu Arg Ile Gln Arg Lys Lys Arg Asp Ile Thr Gln Leu  
 370 375 380

Leu Ser Lys His Lys His Thr Leu Val Glu Asp Lys Val Glu Val Val  
 385 390 395 400

Pro Lys Gln Pro Thr Val Leu Asp Leu Phe Thr Lys Ser Leu His Glu  
 405 410 415

Lys Asp Gly Cys Glu Val Leu Ser Arg Lys Leu Phe Lys Phe Gly Asp  
 420 425 430

Lys Glu Ile Leu Ala Ile Ser Thr Lys Val Gln Asn Lys Thr Glu Val  
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His Leu Ala Thr Asn His Thr Asp Pro Leu Ile Leu His Trp Ser Leu  
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Ala Lys Asn Ala Gly Glu Trp Lys Ala Pro Ser Pro Asn Ile Leu Pro  
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Ser Gly Ser Thr Leu Leu Asp Lys Ala Cys Glu Thr Glu Phe Thr Lys  
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Asp Gly Gly Tyr Lys Gly Met Pro Phe Val Leu Arg Ser Gly Glu Thr  
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Trp Lys Lys Asn Asn Gly Ser Asp Phe Phe Leu Asp Phe Ser Thr His  
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Asp Val Arg Asn Ile Lys Leu Lys Gly Asn Gly Asp Ala Gly Lys Gly  
 545 550 555 560

Thr Ala Lys Ala Leu Leu Glu Arg Ile Ala Asp Leu Glu Glu Asp Ala  
 565 570 575

Gln Arg Ser Leu Met His Arg Phe Asn Ile Ala Ala Asp Leu Ala Asp  
 580 585 590

Gln Ala Arg Asp Ala Gly Leu Leu Gly Ile Val Gly Leu Phe Val Trp  
 595 600 605

Ile Arg Phe Met Ala Thr Arg Gln Leu Thr Trp Asn Lys Asn Tyr Asn  
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610

615

620

Val Lys Pro Arg Glu Ile Ser Lys Ala Gln Asp Arg Phe Thr Asp Asp  
625 630 635 640

Leu Glu Asn Met Tyr Lys Ala Tyr Pro Gln Tyr Arg Glu Ile Leu Arg  
645 650 655

Met Ile Met Ala Ala Val Gly Arg Gly Gly Glu Gly Asp Val Gly Gln  
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Arg Ile Arg Asp Glu Ile Leu Val Ile Gln Arg Asn Asn Asp Cys Lys  
675 680 685

Gly Gly Met Met Glu Glu Trp His Gln Lys Leu His Asn Asn Thr Ser  
690 695 700

Pro Asp Asp Val Val Ile Cys Gln Ala Leu Ile Asp Tyr Ile Lys Ser  
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Asp Phe Asp Ile Ser Val Tyr Trp Asp Thr Leu Asn Lys Asn Gly Ile  
725 730 735

Thr Lys Glu Arg Leu Leu Ser Tyr Asp Arg Ala Ile His Ser Glu Pro  
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Asn Phe Arg Ser Glu Gln Lys Ala Gly Leu Leu Arg Asp Leu Gly Asn  
755 760 765

Tyr Met Arg Ser Leu Lys Ala Val His Ser Gly Ala Asp Leu Glu Ser  
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Ala Ile Ala Ser Cys Met Gly Tyr Lys Ser Glu Gly Glu Gly Phe Met  
785 790 795 800

Val Gly Val Gln Ile Asn Pro Val Lys Gly Leu Pro Ser Gly Phe Pro  
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Glu Leu Leu Glu Phe Val Leu Glu His Val Glu Asp Lys Ser Ala Glu  
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Pro Leu Leu Glu Gly Leu Leu Glu Ala Arg Val Glu Leu Arg Pro Leu  
835 840 845

Leu Leu Asp Ser Arg Glu Arg Met Lys Asp Leu Ile Phe Leu Asp Ile  
850 855 860

Ala Leu Asp Ser Thr Phe Arg Thr Ala Ile Glu Arg Ser Tyr Glu Glu  
Page 94

865		870		875		880
Leu Asn Asp Ala	Ala Pro Glu Lys Ile	Met Tyr Phe Ile Ser	Leu Val			
	885	890	895			
Leu Glu Asn	Leu Ala Leu Ser Ile	Asp Asp Asn Glu Asp	Ile Leu Tyr			
	900	905	910			
Cys Leu Lys	Gly Trp Asn Gln Ala	Leu Glu Met Ala Lys	Gln Lys Asp			
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Ala Leu Ala Ser Lys	Gly Glu Gln Tyr His	Asn Met Met Gln Pro	Ser			
	945	950	955	960		
Ala Glu Tyr Leu	Gly Ser Leu Leu Ser	Ile Asp Gln Trp Ala	Val Asn			
	965	970	975			
Ile Phe Thr	Glu Glu Ile Ile Arg	Gly Gly Ser Ala Ala	Thr Leu Ser			
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Ala Leu	Leu Asn Arg Phe Asp Pro	Val Leu Arg Asn Val	Ala His Leu			
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Gly Ser	Trp Gln Val Ile Ser	Pro Val Glu Val Ser	Gly Tyr Val			
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Val Val	Val Asp Glu Leu Leu	Ala Val Gln Asn Lys	Ser Tyr Asp			
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Lys Pro	Thr Ile Leu Val Ala	Lys Ser Val Lys Gly	Glu Glu Glu			
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Ile Pro	Asp Gly Val Val Gly	Val Ile Thr Pro Asp	Met Pro Asp			
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Val Leu	Ser His Val Ser Val	Arg Ala Arg Asn Ser	Lys Val Leu			
	1070	1075	1080			
Phe Ala	Thr Cys Phe Asp His	Thr Thr Leu Ser Glu	Leu Glu Gly			
	1085	1090	1095			
Tyr Asp	Gln Lys Leu Phe Ser	Phe Lys Pro Thr Ser	Ala Asp Ile			
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Thr Tyr	Arg Glu Ile Thr Glu	Ser Glu Leu Gln Gln	Ser Ser Ser			

1115	1120	1125
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Gln Glu Asp Phe Ser Ala Leu Gly Glu Ile Arg Lys Val Val Leu 1220 1225 1230		
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Met Leu Gly Ser Gly Met Pro Trp Pro Gly Asp Glu Gly Asp Lys 1250 1255 1260		
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Lys Trp Asn Glu Arg Ala Tyr Phe Ser Thr Arg Lys Val Lys Leu 1280 1285 1290		
Asp His Glu Tyr Leu Ser Met Ala Val Leu Val Gln Glu Val Val 1295 1300 1305		
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Gly Asp Ser Ser Glu Ile Tyr Ala Glu Val Val Lys Gly Leu Gly 1325 1330 1335		
Glu Thr Leu Val Gly Ala Tyr Pro Gly Arg Ala Met Ser Phe Val 1340 1345 1350		
Cys Lys Lys Asp Asp Leu Asp Ser Pro Lys Leu Leu Gly Tyr Pro		



1355

1360

1365

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Leu Tyr Asp Ser Val Pro Met Asp Glu Glu Asp Glu Val Val Leu  
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